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AIRFIL: A FORTRAN PROGRAM FOR REDUCATION OF DATA OBTAINED FROM ALPHA SPECTROMETRY OF PERIMETER AIR FILTERS

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AIRFIL: A FORTRAN PROGRAM FOR REDUCTION OF DATA OBTAINED FROM ALPHA SPECTROMETRY OF PERIMETER AIR FILTERS

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INSERT A 2 See pg 2/6

Starting in the mid 1970's,

(Buildings, 9995)

ABSTRACT

have been

①

Isotopic alpha spectrometry of ^{238}U, ^{235}U, and ^{234}U, ~~along with~~ and gross alpha/beta counting of perimeter air filters, ~~is~~ performed by the Oak Ridge Y-12 Plant Laboratory in support of the Environmental Monitoring Section of the Radiation Safety Department. Weekly samples are gross alpha/beta counted and the isotopic analysis performed on quarterly composites. Calculations and data management ~~represent a major portion of the analysis time when performed manually, even with a desktop calculator.~~ In order to ~~reduce calculation time,~~ perform orderly data manipulation and management, reduce errors due to redundant calculations, and eliminate report typing turnaround time, a computer program (AIRFIL) has been developed that performs these functions. The program accepts data through user prompts, then calculates and prints intermediate and final data, including detection limits.

of air concentrations are set up to the the plant lab. (Hinton, 1984).

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SUMMARY

A FORTRAN program (AIRFIL) has been written to manage raw counting data obtained from perimeter air filters. The program reduces calculation time from hours to only a few minutes, while reducing the possibility of human error. Data are produced in a coherent form that can be easily read. A final report is produced, eliminating typing time and errors.

INTRODUCTION

The Environmental Monitoring Section of the Oak Ridge Y-12 Plant* Radiation Safety Department has the responsibility of monitoring particulate emissions around the Y-12 Plant. Eleven monitoring stations have been placed around the perimeter of the plant. The filters in each system are changed on a weekly basis and are sent to the Plant Laboratory for gross alpha/beta counting. The weekly filters from each site are composited and analyzed quarterly for ^{238}U, ^{235}U, and ^{234}U by alpha spectroscopy. In order to arrive at quarterly concentration values reported in microcuries per cubic centimeter of air, several calculations are involved. A FORTRAN program (AIRFIL) has been written which manages all the raw input data, calculates the final concentrations and prints both raw data and final report in a matter of minutes.

This report describes the analysis and the FORTRAN program used in this procedure. Copies of the procedure and the program are included in Appendices A and B, respectively.

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*Operated for the U.S. Department of Energy by the Union Carbide Corporation.

PROCEDURE

2

Gross Alpha/Beta Counting

The filter halves are counted for five minutes on a Sharp alpha/beta proportional counter with an alpha efficiency of 30% and a beta efficiency of 45%. The fact that the samples are collected on paper filters affects counting efficiency, therefore absorption factors (paper factors) are applied to the instrumental efficiencies. Paper factors for this particular filter paper (Whatman 41) have been determined to be 0.73 for beta and 0.51 for alpha counting.

2

Sample Preparation for Isotopic Uranium Alpha Counting

The samples are prepared for isotopic alpha counting using the procedure found in Appendix A of this report.

Isotopic Uranium Alpha Counting

An alpha spectrometer equipped with 600 mm^2 silicon surface barrier detectors and a multichannel analyzer is used. The detectors have an alpha efficiency of 10-15% in the configuration used. The efficiency is determined by using an in-house standard containing ^{238}U, ^{235}U and ^{234}U. Regions of interest for the isotopes are also determined with this standard. After the instrument has been calibrated, each sample is counted 60 minutes. ^{232}U counts are used to calculate a recovery factor which is applied to each isotopic count (Hinton, 1984

FORTRAN PROGRAM

A FORTRAN program called AIRFIL has been written to perform all data manipulations and calculations. The following discussion describes AIRFIL and the equations it uses.

All data for AIRFIL are entered via the keyboard in response to appropriate prompts. The year and quarter during which the samples were collected are stored to identify the sample set on the final report heading. Next, a series of background data is requested, which includes the counting time in minutes and the number of days over which the samples were counted. Although as many as three detectors can be used, the analyses require a few days, making it necessary to enter the day number to correctly identify the daily variant information.

Planchet blank values are an indication of the baseline status of the detectors under conditions which closely simulate the counting of the samples. These values are determined each morning and vary slightly from day to day and from detector to detector. There is a planchet blank value for each of the four uranium isotopes of interest for each detector each day over which the samples were counted. These values are requested by the program.

Next, values for uranium standards containing ^{238}U, ^{235}U and ^{234}U are requested. Like planchet blanks, the standards are counted in each detector each day of counting. Also requested are the total disentegrations per minute (dpm) contained on each standard.

Using the above data, the first calculations performed by the program are the detector efficiencies. An efficiency is determined for each detector on each counting day. In the calculation, the appropriate planchet blank is subtracted from each isotopic standard value. The equation is

$$E(n,d)=[SV(i,n,d)-PB(i,n,d)]/T/G(n,d) \tag{1}$$

where:

E(n,d)=Efficiency of detector n on day d

SV(i,n,d)=Standard count value of isotope i in detector n on day d,

PB(i,n,d)=Planchet blank value of isotope i in detector n on day d,

T=Counting time in minutes, and

G(n,d)=Total dpm of ^{238}U, ^{235}U and ^{234}U on planchet in detector n on day d

All samples are spiked with a small amount (10-15 dpm) of ^{232}U as an internal standard. Normally, the spike contains traces of ^{238}U, ^{235}U, and ^{234}U along with the ^{232}U. These additional counts are of course added to the samples along with the internal standard. To compensate for this and to monitor sample contamination throughout the procedure, three sample blanks are spiked and carried through the procedure along with the samples. The blanks consist of the same type filter paper (Whatman 41) and the same number of filters as the samples.

A gross alpha/beta count is made on each filter half. The filters are held a minimum of three days before they are counted to allow possible thorium daughters to decay. Once counted, the filters from each site are retained until the end of the quarter so that isotopic uranium alpha determinations can be made on each site composite. The raw alpha/beta counts are converted to dpm using the following equations:

Alpha Dpm=2[ACNTS-ABKG/T/0.51/AEFF] (4)

where:

ACNTS=Alpha counts,
ABKG=Instrument alpha background counts,
T=Counting time in minutes,
AEFF=Detector alpha efficiency,
2=Factor to convert dpm per half filter to dpm per total filter, and
0.51=Alpha paper factor.

And

Beta Dpm=2[BCNTS-BBKG/T/0.73/BEFF] (5)

where:

BCNTS=Beta counts,
BBKG=Instrument beta background counts,
T=Counting time in minutes,
BEFF=Detector beta efficiency,
2=Factor to convert dpm per half filter to dpm per total filter, and
0.73=Beta paper factor.

The alpha/beta dpm for each site are summed to obtain total gross alpha/beta dpm per site per quarter. The dpm are then converted to microcuries for final output.

The beginning and ending air flows from each site and the number of days between installation and removal of the filters are used in the following equation to calculate the volume of air in cubic meters pulled through each filter.

FLO=[FLOW1+FLOW2]/2[DAYS][0.0283m**3/ft**3][1440min/day] (6)

where,

FLO=Total flow in cubic meters
FLOW1=Initial flow in cfm
FLOW2=Final flow in cfm, and
Days=Number of days in sampling period.

The weekly volumes are summed to arrive at the total cubic meters of air collected at a site during the quarter. The cubic meters are then converted to cubic centimeters to accommodate the requested output. The total gross alpha/beta concentrations are reported as microcuries per cubic centimeter.

Counts for the three uranium isotopes of interest and the ^{232}U internal standard are entered along with the detector number and the counting day number on which the composite was counted. A sample recovery value is calculated as in Equation (2). Again, if the recovery exceeds one, the value is written to the terminal to inform the analyst that a potential problem may exist and that the recovery has been set to 1.000 for the remainder of the calculation.

The sample counts for each isotope are then converted to dpm as in Equation (3). Once this is completed, the program subtracts the appropriate average sample blank dpm from each isotope. This cycle is repeated until the data from each site is entered.

Detection limits are calculated for each isotope and for the gross alpha/beta values. By convention, the detection limits are calculated as twice the value of the square root of the background levels. However, there are details which need to be amplified. The determination of the isotopic detection limits begins with the conversion of the sample blank counts to dpm, with no planchet blank subtraction. The values for a given isotope from each of the sample blanks are then averaged. This produces three background values, one for each isotope of interest. As in the samples, the number of dpm for each isotope is doubled to represent a total filter. The square roots of these numbers are then multiplied by 2 and divided by the average air volume per site, followed by conversion to microcuries per cubic centimeter.

The gross alpha/beta detection limits are determined by averaging the alpha and beta detector backgrounds. Unlike the isotopic limits, the averaged values are not doubled since they reflect only empty counter backgrounds and not filters. Two times the square roots of these averages are divided by the average air volume per site.

AIRFIL produces a disk file which contains a summary of the preliminary data as entered by the analyst and several intermediate results. Two copies of a final report follow, which list the isotopic and gross alpha/beta values in microcuries per cubic centimeter. Detection limits are listed at the end of each data column. A brief summary of the major equations used in AIRFIL is presented. A line is provided for a signature which verifies that the report has been reviewed and approved.

This program works well and has fulfilled its goals of reduced calculation time, orderly data manipulation and management, reduced errors due to redundant calculations and eliminated typing turnaround time. However, the program is not perfect since it requires considerable keyboard data entry. Future work will be directed to on-line data aquisition for as much data as possible.

APPENDIX A

RADIOCHEMICAL METHOD FOR DETERMINING URANIUM IN AIR FILTERS

1. Scope and Application

This method is applicable to the determination of the isotopes of uranium in paper and Hollingsworth types of air filters.

2. Summary of Method

2.1 ^{232}Uranium tracer is added to the dissolved filter solution and equilibrated with the uranium in the sample. Plutonium and thorium are separated by adsorption on anion exchange resin under conditions that allow uranium to remain inthe effluent. Repeated liauid-liquid extractions withmethyl isobutyl ketone (hexone) are used to purify the uranium. The final hexone extract is dried on a stainless steel plate, and the determination of the uranium isotopes is made by alpha spectrometric measurements using a silicon surface-barrier detector to count the plate.

2.2 The lowest concentration reported is 0.04 pCi/total. Typically for filters that have filtered 1 X 10^3m of air, the lowest concentration reported then is 4 X 10^{-5} pCi/m^3.

3. Sample Handling and Preservation

Filters should be handled as little as possible to avoid loss of particulates and should be stored in plastic containers such as polyethylene bags..

4. Interferences

4.1 Iron in concentrations of milligrams per gram of sample tends to follow uranium throughout the chemistry and causes serious degradation of alpha measurements.

4.2 ^{234}Uranium cannot be distinguished easily from ^{233}uranium.

5. Apparatus

5.1 Analytical balance

5.2 Muffle furnace

5.3 Hot plate

5.4 Centrifuge

5.5 Vortex mixer

5.6 Extraction vials, 50-mL with plastic-lined screw caps

5.7 Teflon beakers, 250-mL size

5.8 Transfer pipettes

5.9 Lab glassware

5.9.1 Beakers, 100-, 250-, and 600-mL
5.9.2 Centrifuge tubes, 50-mL glass
5.9.3 Glass ion-exchange column, 0.8 cm ID by 25 cm long, fitted with a stopcock and reservoir

5.10 Stainless steel disks

5.11 Multichannel analyzer system with silicon surface-barrier detector(s)

6. Reagents

6.1 Nitric acid (HNO_3), concentrated

6.2 Nitric acid (HNO_3), 8M: Add 500 ml of concd HNO_3 to 500 mL of water.

6.3 Aluminum nitrate solution [$Al(NO_3)_3$], 2.8M: Dissolve 1050 grams of aluminum nitrate nonahydrate [$Al(NO_3)_3$] x $9H_2O$ in a minimum of water with heat. Cautiously add 100 mL of concd ammonium hydroxide (NH_2OH) with stirring until all of the precipitate dissolves; dilute to 1 liter with water.

6.4 Sodium nitrite ($NaNO_2$), crystals

6.5 Methyl isobutyl ketone (hexone)

6.6 Potassium bromate ($KBrO_3$), crystals

6.7 ^{232}Uranium tracer solution: Dilute a stock solution ^{232}uranium to a concentration of 10 dis/min/mL.

6.8 Anion exchange resin: Dowex 1 x 4 (50-100 mesh, chloride form) or equivalent.

6.9 Hydrogen peroxide (H_2O_2), 30% solution

6.10 Hydrofluoric acid (HF), concentrated

7. Procedure

7.1 Weigh an aliquot of the filter(s) and place in an adequately sized beaker. Relate weight to total sample to determine air-flow volume.

7.2 Place the beaker and sample in a muffle furnace and set the temperature to 210°C.

7.3 Carbonize the sample by allowing it to remain at 210°C for 8 h.

7.4 Raise the temperature of the furnace to 375°C and allow the sample to ash at this temperature for 16 h; finally ash at 525°C for 24 h.

7.5 Transfer the ashed sample to a 250-mL Teflon beaker.

7.6 Add 25 mL of concd HNO_3 and 25 mL of concd HF.
NOTE - Paper filters may be completely soluble in HNO_3; therefore, the addition of HF may be excluded, and the procedure can be continued at step 7.14.

7.7 Place the sample on a hot plate and take to dryness.

7.8 Repeat steps 7.6 and 7.7 twice.

7.9 Add 15 mL of concd HNO_3 and take to dryness.

7.10 Repeat step 7.9 twice.

7.11 Take up the residue in 25 mL of 8M HNO_3 and 3 to 5 ml of H_2O.

7.12 Transfer the sample to the original ashing beaker.

7.13 Place the beaker on a hot plate and digest with the addition of 30% H_2O in 1-mL portions until the solution is clear.

7.14 Add 1.00 mL of 10 dis/min/mL ^{232}uranium tracer solution.

7.15 Adjust the acidity to 8M HNO_3.

7.16 Add 250 mg of $NaNO_2$ crystals; place on hot plate; bring to a boil rapidly; immediately remove from heat and allow the sample to digest for 20 min.

7.17 While the sample is digesting, prepare a resin column as follows.

7.17.1 Place a glass-wool plug in the bottom of the column described in step 5.9.3.
7.17.2 Slurry the resin (see step 6.8) with water and immediately discard the fines by decanting. Repeat as necessary until fines are removed.
7.17.3 Transfer 4 mL of resin to the column with water. Prevent any channeling by maintaining the solution level above the resin by use of the stopcock.
7.17.4 Place a glass-wool plug on top of the resin.
7.17.5 Convert the resin to the nitrate form by passing several column volumes of 8M HNO_3 through the column until the resin is free of chloride ions.

7.18 Transfer the sample solution, which should be at room temperature, to the prepared resin column.

7.19 Place a 250-mL beaker beneath the column and allow the sample solution to drain into the beaker at a flow rate of 2 mL/min.

7.20 Rinse the beaker with 25 mL of 8M HNO_3 and transfer the rinse to the column.

7.21 Allow the rinse to drain into the beaker also.

7.22 Place the beaker containing the column effluent on a hot plate and take to dryness.

7.23 Dissolve the residue in 10 mL of $Al(NO_3)_3$ solution and transfer to an extraction vial using a minimum of $Al(NO_3)_3$ to rinse the beaker.

7.24 Add an equal volume of hexone and extract on a Vortex mixer for 10 min.

7.25 Centrifuge for 2 min to separate the phases and discard the aqueous phase.

7.26 Add an equal volume of water and back-extract into the water on Vortex mixer for 10 min.

7.27 Centrifuge for 2 min. to separate the phases.

7.28 Transfer the aqueous phase to a 100-mL beaker.

7.29 Repeat steps 7.26, 7.27, and 7.28.

7.30 Place the beaker containing the water strip solution on a hot plate and take to dryness.

7.31 Add enough 8M HNO_3 to moisten the residue.

7.32 Add 10 to 20 mg of $KBrO_3$ crystals and digest for 10 min.

7.33 Dissolve and transfer the residue to an extraction vial with 5 mL of $Al(NO_3)_3$ solution.

7.34 Repeat step 7.24 using 1 mL of hexone; repeat step 7.25.

7.35 Transfer the entire hexone extract by drops to a stainless steel disk placed on a hot plate set at 100°C.

7.36 Flame the disk to a red heat.

7.37 Measure the uranium alpha activities by pulsing with a silicon surface-barrier detector and multichannel analyzer.

```
C*******************************************************
C
C       AIR FILTER CALCULATION PROGRAM
C
C         APRIL 1983     RL HOWELL
C
C*******************************************************
C       THIS PROGRAM CALCULATES THE CONCENTRATION OF U238, U235, AND
C       U234 IN AIR FILTERS SAMPLING THE Y-12 AREA. DATA INCLUDING
C       COUNTER BLANK COUNTS, STANDARDS, FLOW DATA, AND GROSS ALPHA
C       AND BETA COUNTS ARE ENTERED. A REPORT FILE, AIRRPT.DAT, IS
C       GENERATED WHICH CONTAINS INTERMEDIATE DATA AND A FINAL
C       REPORT. THE PROGRAM CAN HANDLE UP TO 22 SAMPLING SITES, 20
C       FILTERS PER SITE, 3 DETECTORS, AND 5 COUNTING DAYS. THE
C       DETECTION LIMITS ARE CALCULATED AS 2 * SQRT (BACKGROUND).
C       ALL FILTER RESULTS ARE MULTIPLIED BY 2 TO ACCOUNT FOR THE
C       TOTAL FILTER.
C
C
        DIMENSION ISOTPE(4), PLN(4,3,5), STD(3,3,5), ISAM(3)
        DIMENSION FLO1(22,20), FLO2(22,20), A(22,20), B(22,20), ALP(22)
        DIMENSION BET(22), DCTR(3), GROSS(3,5), BLK(4,3), ABKG(20)
        DIMENSION COUNTS(4,22), DAYS(22), IDET(22), IDAY(5)
        DIMENSION BLKAVG(3), SUMFLO(22), BLKCNT(4,3), DPMS(4,22)
        DIMENSION BEFF(20), ACNTS(22,20), BCNTS(22,20), DPMFIL(3,22)
        DIMENSION DPMLIM(3),  BLKLIM(3,3), BBKG(20), AEFF(20)
        DIMENSION ALPFIL(22), BETFIL(22)
C
C  ! DATA INITIALIZATION !
C
        DATA ISOTPE(1)/238/, ISOTPE(2)/235/, ISOTPE(3)/234/
        DATA ISOTPE(4)/232/, DCTR(1)/'A'/, DCTR(2)/'B'/, DCTR(3)/'C'/
        DATA ISAM(1)/1/, ISAM(2)/2/, ISAM(3)/3/

        INTEGER*2       DETNUM, DAYNUM
        REAL*4  TIME,EFF(3,5),INTSTD
C
C       ENTER YEAR AND QUARTER FOR REPORT
C
        WRITE (5,8)
 8        FORMAT(1X,18X,'*** AIR FILTER CALCULATION PROGRAM ***',///,
        1   1X,'ENTER YEAR IN WHICH SAMPLES WERE COLLECTED '
        2   '(4 DIGITS): ',$)
        READ (5,2) IYEAR
 2      FORMAT (I4)
        WRITE (5,3)
 3      FORMAT (1X,'ENTER QUARTER: ',$)
        READ (5,4) IQTR
 4      FORMAT (I1)
C
C       ENTER COUNTING PARAMETERS
C
```

```
      WRITE(5,5)
5     FORMAT(1X,'ENTER COUNTING TIME IN MINUTES: ',$)
      READ (5,6) TIME
6     FORMAT (F3.0)
      WRITE (5,10)
10    FORMAT (1X,'ENTER NUMBER OF DAYS OVER WHICH',
      1  ' SAMPLES WERE COUNTED: ',$)
      READ (5,11) NDAYS
11    FORMAT (I1)
C
C
C     ENTER PLANCHET BLANKS
C
      DO 26 J=1,NDAYS
 12      DO 25 I=1,3    ! DETECTORS !
      DO 23 N=1,4    ! ISOTOPES !
      WRITE (5,15) ISOTPE(N), DCTR(I), J
15    FORMAT(1X,'ENTER U',I3,' PLANCHET BLANK FOR DETECTOR ',1A,
      1    ' ON DAY NUMBER ',I1,': ',$)
      READ (5,20) PLN(N,I,J)
 20      FORMAT(F3.0)
 23   CONTINUE
 25   CONTINUE
26    CONTINUE
C
C
C
C     ENTER STANDARD COUNTS
C
      DO 42 J=1,NDAYS
      DO 40 I=1,3
      DO 38 N=1,3
      WRITE (5,30) ISOTPE(N), DCTR(I), J
30    FORMAT(1X,'ENTER U',I3,' STANDARD COUNT FOR DETECTOR ',1A,
      1    ' ON DAY NUMBER ',I1,': ',$)
      READ(5,35) STD(N,I,J)
35    FORMAT(F3.0)
38    CONTINUE
40    CONTINUE
42    CONTINUE
C
C
C
C     ENTER GROSS DPM
C
C
      DO 55 J=1,NDAYS
      DO 54 I=1,3
      WRITE (5,43) DCTR(I), J
43    FORMAT(1X,'ENTER GROSS DPM FOR DETECTOR ',1A,' ON DAY NUMBER ',
      1    I1,': ',$)
      READ (5,50) GROSS(I,J)
 50      FORMAT(F5.0)
 54      CONTINUE
 55   CONTINUE
```

```
C
C
C
C
C  ! CALCULATE EFFICIENCY !
C
         TEMP = 0
         DO 70 J=1,NDAYS
         DO 63 N=1,3    ! DETECTOR NUMBER !
         DO 62 I=1,3    ! ISOTOPE !
         TMP1=STD(I,N,J) - PLN(I,N,J)
         TEMP = TEMP + TMP1
 62         CONTINUE
         EFF(N,J) = TEMP / TIME / GROSS(N,J)
         TEMP = 0
 63         CONTINUE
70       CONTINUE
C
C        ENTER SPIKE DPM

         WRITE (5,64)
64       FORMAT (1X,'ENTER THE SPIKE DPM: ',$)
         READ (5,80) SPK
80       FORMAT(F3.0)
C
C
C        ENTER SAMPLE BLANK DATA
C
C
         DO 75 I=1,3     !SAMPLE BLANK NUMBER!
         WRITE (5,65) I
65       FORMAT(1X,'ENTER DETECTOR NUMBER FOR SAMPLE BLANK ',I1,': ',$)
         READ (5,66) DETNUM
 66         FORMAT(I1)
         WRITE (5,56) I
56       FORMAT (1X,'ENTER THE DAY NUMBER FOR SAMPLE BLANK ',I1,': ',$)
         READ (5,57) DAYNUM
57       FORMAT (I1)
C
         DO 74 N=1,3
         WRITE(5,69) ISOTPE(N), I
69       FORMAT(1X,'ENTER U',I3,' COUNTS FOR SAMPLE BLANK ',I1,': ',$)
         READ (5,71) BLKCNT(N,I)
71       FORMAT(F3.0)
C
74       CONTINUE
         WRITE (5,45) I
45       FORMAT (1X,'ENTER U232 COUNTS FOR SAMPLE BLANK ',I1,': ',$)
         READ (5,46) INTSTD
46       FORMAT (F3.0)
C        SUBTRACT PLANCHET BLANK FROM THE INTERNAL STANDARD
         INTSTD = INTSTD - PLN(4, DETNUM, DAYNUM)
```

```
C       CALC RECOVERY FOR SAMPLE BLANKS
        BLKREC = INTSTD / TIME / EFF(DETNUM, DAYNUM) / SPK
        IF (BLKREC .LT. 1.) GOTO 351
        WRITE (5,350) I, BLKREC
350     FORMAT (1X,'THE RECOVERY VALUE FOR SAMPLE BLANK ',
        1   I1,' WAS ',F7.4,'. IT HAS BEEN RESET TO 1.000')
        BLKREC = 1.
351     CONTINUE
C
C       CONVERT SAM BLK CNTS TO DPM
C
        DO 49 N=1,3     !ISOTOPES!
        BLK(N,I) = (BLKCNT(N,I) - PLN(N,DETNUM,DAYNUM)) / TIME
        1   / EFF(DETNUM, DAYNUM) / BLKREC
        BLKLIM(N,I)=BLKCNT(N,I) / TIME / EFF(DETNUM,DAYNUM) / BLKREC
49      CONTINUE
75      CONTINUE
C
C
C       AVERAGE THE ISOTOPES IN THE SAM BLKS AND CALC DETECTION LIMITS
C
        TMP4 = 0
        TMP2 = 0
        DO 78 N=1,3     !ISOTOPE!
        DO 77 I=1,3     !SAMPLE!
        TMP1 = BLK(N,I)
        TMP2 = TMP2 + TMP1
        TMP3 = BLKLIM(N,I)
        TMP4 = TMP4 + TMP3
77      CONTINUE
        BLKAVG(N) = TMP2 / 3.
        DPMLIM(N) = TMP4 / 3.
        DPMLIM(N) = 2. *.SQRT(2. * DPMLIM(N))
        TMP2 = 0
78      CONTINUE
C
C
C       NOW ENTER SAMPLE DATA
C
C
        WRITE(5,81)
81      FORMAT(1X,'ENTER NUMBER OF SAMPLE SITES: ',$)
        READ (5,82) NSITES
82      FORMAT(I2)
C
C
        WRITE (5,85)
85      FORMAT(1X,'ENTER NUMBER OF FILTERS COMPOSITED FROM EACH SITE: ',$)
        READ (5,86) NFILTR
86      FORMAT(I2)
        ALPBKG = 0
        BETBKG = 0
        DO 110 N = 1,NFILTR
```

```
C
      DO 90 I=1,NSITES
      WRITE (5,88) I,N
 88   FORMAT(1X,'ENTER FLOW 1 FOR SITE ',I2,' FILTER ',I2,': ',$)
      READ (5,89) FLO1(I,N)
 89     FORMAT(F3.1)
 90   CONTINUE
      DO 92 I = 1, NSITES
      WRITE (5,91) I,N
 91   FORMAT (1X,'ENTER FLOW 2 FOR SITE ',I2,' FILTER ',I2,': ',$)
      READ (5,89) FLO2(I,N)
 92   CONTINUE
C
      WRITE (5,93)
 93     FORMAT(1X,6X,'NUMBER OF DAYS = ',$)
      READ (5,94) DAYS(N)
 94     FORMAT(F2.0)
      WRITE (5,95) N
 95   FORMAT (1X,'ENTER ALPHA BACKGROUND FOR FILTER ',I2,': ',$)
      READ (5,97) ABKG(N)
      WRITE (5,96) N
 96   FORMAT (1X,'ENTER BETA  BACKGROUND FOR FILTER ',I2,': ',$)
      READ (5,97) BBKG(N)
 97   FORMAT (F3.0)
      WRITE (5,98)
 98   FORMAT (1X,'ENTER ALPHA METAL EFFICIENCY: ',$)
      READ (5,100) AEFF(N)
      WRITE (5,99)
 99   FORMAT (1X,'ENTER BETA  METAL EFFICIENCY: ',$)
      READ (5,100) BEFF(N)
100   FORMAT (F4.2)
      WRITE (5,101)
101   FORMAT (1X,'ENTER ALPHA/BETA COUNTING TIME: ',$)
      READ (5,102) CTIME
102   FORMAT (F2.0)
      DO 105 I = 1, NSITES
      WRITE (5,103) I, N
103   FORMAT (1X,'ENTER ALPHA COUNTS FOR SITE ',I2,' FILTER ',I2,': ',$)
      READ (5,104) ACNTS(I,N)
104   FORMAT (F6.0)
C
C     CONVERT COUNTS TO DPM

      A(I,N) = 2. *  (ACNTS(I,N) - ABKG(N))/(CTIME * 0.51 * AEFF(N))
105   CONTINUE
      AABKG = ABKG(N) / (CTIME * 0.51 * AEFF(N))
      DO 107 I = 1, NSITES
      WRITE (5,106) I, N
106   FORMAT(1X,'ENTER BETA  COUNTS FOR SITE ',I2,' FILTER ',I2,': ',$)
      READ (5,104) BCNTS(I,N)
C
C     CONVERT COUNTS TO DPM
```

```
      B(I,N) = 2. *  (BCNTS(I,N) - BBKG(N)) / (CTIME * 0.73 * BEFF(N))
107   CONTINUE
      BBBKG = BBKG(N) / (CTIME * 0.73 * BEFF(N))
C
C     SUM ALP AND BETA BKGS TO AVERAGE LATER
C
      ALPBKG = ALPBKG + AABKG
      BETBKG = BETBKG + BBBKG
110   CONTINUE
C
C     SUM ALP AND BETA DPMS AT EACH SITE
C
      DO 112 I=1,NSITES
      DO 111 N=1,NFILTR
      TMP1 = A(I,N)
      TMP2 = B(I,N)
      ALP(I) = ALP(I) + TMP1
      BET(I) = BET(I) + TMP2
111   CONTINUE
112   CONTINUE
C
C     NOW AVERAGE ALP AND BETA BACKGROUNDS
C
      FILTRS = NFILTR
      ALPBKG = ALPBKG / FILTRS
      BETBKG = BETBKG / FILTRS
C
C     ! CHANGE FLOW DATA IF MISTAKES WERE ENTERED !
C
113   WRITE (5,114)
114   FORMAT (1X,10X,'0 -- FLOW DATA ENTERED CORRECTLY',/
      1   1X,10X,'1 -- FLOW DATA NEEDS CORRECTION',/
      2   1X,10X,'     ENTER SELECTION: ',$)
      READ (5,115)IEDIT
115   FORMAT (I1)
      IF (IEDIT .EQ. 0) GO TO 124
      WRITE (5,116)
116   FORMAT (1X,'ENTER FILTER NUMBER: ',$)
      READ (5,117) IFIL
117   FORMAT (I2)
      WRITE (5,118)
118   FORMAT (1X,'ENTER SITE NUMBER: ',$)
      READ (5,119) ISIT
119   FORMAT (I2)
      WRITE (5,120)
120   FORMAT (1X,'ENTER FLOW 1: ',$)
      READ (5,121) ANS
121   FORMAT (F3.1)
      FLO1(ISIT, IFIL) = ANS
      WRITE (5,122)
```

```
122     FORMAT (1X,'ENTER FLOW 2: ',$)
        READ (5,121) ANS
        FLO2(ISIT,IFIL) = ANS
        WRITE (5,123)
123     FORMAT (1X,'THE CHANGE HAS BEEN MADE.')
        GO TO 113
C
C  !NOW ENTER ISOTOPIC DATA !
C
C
124     DO 155 I=1,NSITES
        WRITE (5,125)
125     FORMAT(1X,///,1X,18X,'*** DATA ENTRY ***',//)
        WRITE (5,126) I
126     FORMAT(1X,'FOR SITE NUMBER ',I2,': ')
        WRITE (5,127)
127     FORMAT(1X,6X,'ENTER DETECTOR NUMBER: ',$)
        READ (5,128) IDET(I)
128     FORMAT (I1)
        DETNUM = IDET(I)
C
        WRITE (5,129)
129     FORMAT (1X,6X,'ENTER DAY NUMBER: ',$)
        READ (5,132) DAYNUM
132     FORMAT (I1)
        IDAY(I) = DAYNUM
C
C
        DO 140 N=1,4      !ISOTOPES!
        WRITE (5,130) ISOTPE(N)
130     FORMAT(1X,6X,'U',I3,' COUNTS: ',$)
        READ (5,131) COUNTS(N,I)
131     FORMAT(F6.0)
140     CONTINUE
C
C       CALCULATE RECOVERY
C
        RCV=(COUNTS(4,I)-PLN(4,DETNUM,DAYNUM))/TIME/EFF(DETNUM,DAYNUM)/SPK
        IF (RCV .LT. 1.) GOTO 145
        WRITE (5,141) I, RCV
141     FORMAT(1X,'THE RECOVERY FOR SITE ',I2,' SAMPLES WAS',
        1   F7.4,'.',/,1X,'IT HAS BEEN RESET TO 1.000')
        RCV = 1.
145     CONTINUE
C
C       CONVERT COUNTS TO DPM
C
        DO 150 N=1,3     ! ISOTOPES !
        DPMS(N,I)=(COUNTS(N,I)-PLN(N,DETNUM,DAYNUM)) / TIME
        1   / EFF(DETNUM,DAYNUM) / RCV
        DPMS(N,I) = DPMS(N,I) - BLKAVG(N)
        IF (DPMS(N,I) .LT. 0) DPMS(N,I) = 0
150     CONTINUE
```

```
155     CONTINUE
C
C
C
C   !CALCULATE CUBIC METERS OF AIR!
C
        SITENO = NSITES
        TOTFLO = 0
        DO 178 I=1,NSITES
        SUMFLO(I) = 0
178     CONTINUE
        DO 185 I=1,NSITES
        DO 180 N=1,NFILTR
        TFLO = ((FLO1(I,M)+FLO2(I,N))/2) * 40.752 * DAYS(N)
        SUMFLO(I) = SUMFLO(I) + TFLO
180     CONTINUE
        TOTFLO = TOTFLO + SUMFLO(I)
185     CONTINUE
        AVGFLO = TOTFLO / SITENO
        DO 188 N=1,3   !ISOTOPES!
        DPMLIM(N) = DPMLIM(N)  / AVGFLO / 2.22E12
188     CONTINUE
C
C
C   !CALCULATE MICROCURIES PER CUBIC CENTIMETER!
C
        DO 190 I=1, NSITES
        DO 189 N=1, 3
        DPMFIL(N,I) = DPMS(N,I) * 2
        DPMS(N,I) = DPMS(N,I) * 2. / SUMFLO(I) / 2.22E12
189     CONTINUE
        ALPFIL(I) = ALP(I)
        BETFIL(I) = BET(I)
        ALP(I) = ALP(I)  / SUMFLO(I) / 2.22E12
        BET(I) = BET(I)  / SUMFLO(I) / 2.22E12
190     CONTINUE
        ALPBKG = 2. * SQRT(ALPBKG) / AVGFLO / 2.22E12
        BETBKG = 2. * SQRT(BETBKG) / AVGFLO / 2.22E12
C
        OPEN (UNIT=2, NAME='AIRFIL.RPT', TYPE='NEW',
        1   FORM='FORMATTED', ACCESS='SEQUENTIAL',
        2   CARRIAGE CONTROL ='FORTRAN')
C  !OUTPUT!
C
        WRITE (2,200)
200     FORMAT(1X, 55X, 'AIR FILTER COMPOSITES REPORT',//,
        1    1X, 63X, 'DATA LISTING',/////)
C
C
C
        WRITE (2,210)
```

```
210     FORMAT(1X,56X,'----- SAMPLE BLANKS -----',//,
        1     1X,45X,'ONE',19X,'TWO',18X,'THREE',/,
        1     1X,38X, 3('COUNTS',6X,'DPM',7X),//)
C
C
C
        WRITE(2,220) (ISOTPE(J),(BLKCNT(J,I),BLK(J,I),I=1,3),J=1,3)
220     FORMAT(1X,20X,'U',I3,14X, 3(F5.0,5X,F5.0,7X),/,1X,20X,'U',
        1    I3,14X, 3(F5.0,5X,F5.0,7X),/,1X,20X,'U',I3,14X
        1    3(F5.0,5X,F5.0,7X),///)
C
C
  ! DETECTOR DATA OUTPUT !
        DO 262 K=1,NDAYS
        WRITE (2,240) K

240     FORMAT (1X,56X,'----- DETECTOR DATA -----',/,1X,66X,
        1    'DAY 'I1,//,1X,44X,
        2    'ONE', 19X, 'TWO', 18X, 'THREE',//)
        WRITE (2,245) (ISOTPE(J),(PLN(J,I,K), I=1,3), J=1,3)
245     FORMAT (1X,'PLANCHET BLANKS',5X,'U',I3,1X,3(17X,F5.0),
        1    /,1X,20X,'U',I3,1X, 3(17X,F5.0),/,1X,20X,'U',I3,
        2    1X, 3(27X,F5.0),//)
        WRITE (2,250) (ISOTPE(J), (STD(J,I,K), I=1,3), J=1,3)
250     FORMAT (1X,'STANDARD COUNTS',5X,'U',13,1X,3(17X,F5.0)
        1    ,/,1X20X,'U',I3,1X,3(17X,F5.0),/,1X,20X,'U',I3,1X,3(17X,F5.0))
        WRITE (2,255) (GROSS(I,K), I=1,3)
255     FORMAT (1X,3X,'GROSS DPM',13X,3(17X,F5.0))
        WRITE (2,260) (EFF(I,K), I=1,3)
260     FORMAT (1X,3X,'EFFICIENCY',14X,3(17X,F5.4),///)
262     CONTINUE
        WRITE (2,360)
360     FORMAT (1X,54X,'----- ALPHA / BETA DATA -----',//,1X,40X,
        1    'BACKGROUND COUNTS',23X,'METAL EFFICIENCY',//,1X,36X,
        2    'ALPHA',15X,'BETA',16X,'ALPHA',14X,'BETA',//)
        WRITE (2,361) (N,ABKG(N),BBKG(N),AEFF(N), BEFF(N), N=1,NFILTRS)
361     FORMAT (1X,20X, 'FILTER ',I2,8X,F3.0,16X,F3.0,16X,F4.2,14X,F4.2)
        WRITE (2,265)
265     FORMAT (///,1X,56X,'----- AIR FLOW DATA -----',//)
        DO 285 I = 1, NSITES
        WRITE (2,270) I, SUMFLO(I)
270     FORMAT(1X,///,1X,60X 'SITE NUMBER ',I2,//,1X,51X,'TOTAL',
        1    ' FLOW = ',F8.1,' CUBIC METERS',//,1X,35X,'FLOW 1',9X,
        2    'FLOW 2',10X,'DAYS',8X,'ALPHA CNTS',4X,'BETA CNTS',//)
        DO 280 J = 1, NFILTR
        WRITE (2,275) J,FLO1(I,J),FLO2(I,J),DAYS(J),ACNTS(I,J),
        1    BCNTS(I,J)
275     FORMAT(1X,20X,'SAMPLE ',I2,5X,F5.1,10X,F5.1,12X,F3.0,
        1    11X,F6.0,10X,F6.0)
280     CONTINUE
285     CONTINUE
        WRITE (2,287) (ISOTPE(N), N=1,4)
```

```
287     FORMAT(1X,///,1X,55X,'----- COUNTS ENTERED -----',//,
        1   1X,40X,3('U',I3,6X),'U',I3,4X,'DETECTOR',4X,'DAY',//)
        DO 289 N=1,NSITES
        WRITE (2,288) N,(COUNTS(I,N),I=1,4),IDET(N), IDAY(N)
288     FORMAT (1X,20X,'SITE NUMBER ',I2,6X,4(F5.0,5X),1X,I1,9X,I1)
289     CONTINUE
        WRITE (2,370)
370     FORMAT (///,1X,53X,'----- PRELIMINARY RESULTS -----',/,1X,47X,
        1   'DISINTEGRATIONS PER MINUTE PER TOTAL FILTER',//,1X,36X,
        2   'U238',11X,'U235',11X,'U234',11X,'ALPHA',10X,'BETA',//)
        DO 375 I = 1,NSITES
        WRITE (2,371) I, (DPMFIL(N,I),N=1,3), ALPFIL(I), BETFIL(I)
371     FORMAT (1X,20X,'FILTER ',I2,5X,5(1PE8.2, 7X))
375     CONTINUE
        DO 330 K = 1,2
        WRITE(2,290)
290     FORMAT('1',48X,41('*'),/,1X,48X,'*',39X,'*',/,1X,
        1   48X,'*',9X,'AIR FILTER COMPOSITES',9X,'*',/,1X,
        2   48X,'*',39X,'*',/,1X,48X,'*',13X,'FINAL REPORT',
        3   14X,'*',/,1X,48X,'*',39X,'*')
        GO TO (291,293,295,297), IQTR
291     WRITE (2,292) IYEAR
292     FORMAT (1X,48X,'*',10X,'FIRST QUARTER, ',I4,10X,'*',
        1   /,1X,48X,'*',39X,'*',/,1X,48X,41('*'),////)
        GO TO 299
293     WRITE (2,294) IYEAR
294     FORMAT (1X,48X,'*',10X,'SECOND QUARTER, ',I4,9X,'*',
        1   /,1X,48X,'*',39X,'*',/,1X,48X,41('*'),////)
        GO TO 299
295     WRITE (2,296) 1YEAR
296     FORMAT (1X,48X,'*',10X,'THIRD QUARTER, ',I4,10X,'*',
        1   /,1X,48X,'*',39X,'*',/1X,48X,41('*'),////)
        GO TO 299
297     WRITE (2,298) IYEAR
298     FORMAT (1X,48X,'*',10X,'FOURTH OUARTER, ',I4,9X,'*',
        1   /1X,48X,'*',39X,'*',/,1X,48X,41('*'),////)
299     WRITE (2,322) (ISOTPE(N), N=1,3)
322     FORMAT(1X,5X,'SITE NUMBER',36X,'MICROCURIES PER CUBIC CENTIMETER',
        1   /,6X,11('-'),36X,32('-'),//,1X,10X,3(16X,'U',I3),12X,
        2   'GROSS ALPHA',10X,'GROSS BETA',/,1X,10X,3(16X,4('-')),
        3   12X,11('-'),10X,10('-'),//)
        DO 320 I=1,NSITES
        N = 1
        IF (DPMS(N,I) . LE. DPMLIM(N)) GO TO 302
        WRITE (2,300) I, DPMS(N,I)
300     FORMAT(1X,9X,I2,12X,1PE9.2, $)
        GO TO 304
302     WRITE (2,303) I, DPMLIM(N)
303     FORMAT (1X,9X,I2,12X, '<', 1PE8.2, $)
304     N = 2
        IF (DPMS(N,I) .LE. DPMLIM(N)) GO TO 306
        WRITE (2,305) DPMS(N,I)
```

```
305     FORMAT ('+', T13,1PE9.2, $)
        GO TO 308
306     WRITE (2,307) DPMLIM(N)
307     FORMAT ('+', T13, '<', 1PE8.2, $)
308     N = 3
        IF (DPMS(N,I) .LE. DPMLIM(N)) GO TO 310
        WRITE (2,309) DPMS(N,I)
309     FORMAT ('+', T13, 1PE9.2, $)
        GO TO 312
310     WRITE (2,311) DPMLIM(N)
311     FORMAT( '+', T13, '<', 1PE8.2, $)
312     IF (ALP(I) .LE. ALPBKG) GO TO 314
        WRITE (2,313) ALP(I)
313     FORMAT ('+',T13, 1PE9.2, $)
        GO TO 316
314     WRITE (2,315) ALPBKG
315     FORMAT ('+', T13, '<', 1PE8.2,$)
316     IF (BET(I) .LE. BETBKG) GO TO 318
        WRITE (2,317) BET(I)
317     FORMAT ('+', T13, 1PE9.2,/)
        GO TO 320
318     WRITE (2,319) BETBKG
319     FORMAT ('+',T13, '<',1PE8.2, /)
320     CONTINUE
        WRITE (2,325) (DPMLIM(N), N=1,3), ALPBKG, BETBKG
325     FORMAT (1X,/,1X,2X,'DETECTION LIMITS:',4X,5(1PE9.2,11X),//)
        WRITE (2,328)
328     FORMAT (1X,2X,'EQUATIONS USED IN THIS REPORT:',//,1X,7X,'DETECTION'
        1    ' LIMIT = (2 * (BACKGROUND ** 0.5)) / AVG FLOW PER SITE',//,1X,
        2    7X,'ISOTOPIC CONC. = (NET CNTS. / TIME / EFF / REC) - (NET'
        3    ' SAM BLK CNTS. / TIME / EFF / REC)',//,1X,7X,'GROSS CONC. ='
        6    'MIN / DAY * 10E6 CM**3 / M**3',//,1X,7X,'ALL VALUES WERE'
        7    ' MULTIPLIED BY 2 TO ACCOUNT FOR THE TOTAL FILTER.',
        8    //,1X,7X,'THESE VALUES WERE CHECKED AND APPROVED BY',
        9    20('_'),'.')
330     CONTINUE
        STOP
        END
C
```

AIR FILTER COMPOSITES REPORT
DATA LISTING

----- SAMPLE BLANKS ----

	ONE COUNTS	ONE DPM	TWO COUNTS	TWO DPM	THREE COUNTS	THREE DPM
U238	0.	0.	2.	0.	2.	0.
U235	3.	0.	0.	0.	1.	0.
U234	17.	2.	18.	2.	6.	1.

----- DETECTOR DATA -----
DAY 1

		ONE	TWO	THREE
PLANCHET BLANKS	U238	1.	0.	2.
	U235	1.	1.	2.
	U234	11.	3.	11.
STANDARD COUNTS	U238	2.	2.	3.
	U235	124.	114.	116.
	U234	177.	181.	174.
GROSS DPM		35.	36.	32.
EFFICIENCY		.1381	.1356	.1448

----- DETECTOR DATA ----

DAY 2

		ONE	TWO	THREE
PLANCHET BLANKS	U238	0.	2.	2.
	U235	2.	0.	1.
	U234	6.	2.	11.
STANDARD COUNTS	U238	24.	24.	29.
	U235	99.	119.	104.
	U234	165.	115.	157.
GROSS DPM		35.	36.	32.
EFFICIENCY		.1333	.1176	.1437

----- DETECTOR DATA ----

DAY 3

		ONE	TWO	THREE
PLANCHET BLANKS	U238	0.	1.	0.
	U235	1.	1.	0.
	U234	1.	2.	0.
STANDARD COUNTS	U238	2.	8.	0.
	U235	115.	133.	0.
	U234	201.	180.	0.
GROSS DPM		35.	35.	1.
EFFICIENCY		.1505	.1510	.0000

----- ALPHA / BETA DATA -----

	BACKGROUND COUNTS		METAL EFFICIENCY	
	ALPHA	BETA	ALPHA	BETA
FILTER 1	10.	22.	0.33	0.49
FILTER 2	10.	22.	0.33	0.49
FILTER 3	10.	22.	0.33	0.49
FILTER 4	9.	22.	0.31	0.47
FILTER 5	9.	22.	0.31	0.47
FILTER 6	9.	22.	0.31	0.47
FILTER 7	9.	25.	0.31	0.48
FILTER 8	9.	25.	0.31	0.48
FILTER 9	10.	24.	0.34	0.48
FILTER 10	10.	24.	0.34	0.48
FILTER 11	9.	26.	0.32	0.47
FILTER 12	10.	16.	0.32	0.46
FILTER 13	11.	19.	0.29	0.40

----- AIR FLOW DATA ----

SITE NUMBER 1
TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	26.	89.
SAMPLE 2	4.0	4.0	7.	25.	70.
SAMPLE 3	4.0	4.0	7.	19.	66.
SAMPLE 4	4.0	4.0	7.	19.	73.
SAMPLE 5	4.0	4.0	7.	12.	70.
SAMPLE 6	4.0	4.0	7.	19.	73.
SAMPLE 7	4.0	4.0	7.	17.	93.
SAMPLE 8	4.0	4.0	7.	19.	151.
SAMPLE 9	4.0	4.0	7.	18.	166.
SAMPLE 10	4.0	4.0	7.	13.	72.
SAMPLE 11	4.0	4.0	7.	118.	142.
SAMPLE 12	4.0	4.0	7.	20.	78.
SAMPLE 13	4.0	4.0	7.	19.	48.

SITE NUMBER 2
TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	17.	90.
SAMPLE 2	4.0	4.0	7.	17.	80.
SAMPLE 3	4.0	4.0	7.	14.	57.
SAMPLE 4	4.0	4.0	7.	15.	110.
SAMPLE 5	4.0	4.0	7.	24.	117.
SAMPLE 6	4.0	4.0	7.	29.	113.
SAMPLE 7	4.0	4.0	7.	23.	105.
SAMPLE 8	4.0	4.0	7.	29.	163.
SAMPLE 9	4.0	4.0	7.	22.	114.
SAMPLE 10	4.0	4.0	7.	16.	74.
SAMPLE 11	4.0	4.0	7.	20.	85.
SAMPLE 12	4.0	4.0	7.	16.	57.
SAMPLE 13	4.0	4.0	7.	17.	95.

SITE NUMBER 3
TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	29.	113.
SAMPLE 2	4.0	4.0	7.	24.	99.
SAMPLE 3	4.0	4.0	7.	29.	97.
SAMPLE 4	4.0	4.0	7.	40.	223.
SAMPLE 5	4.0	4.0	7.	50.	452.
SAMPLE 6	4.0	4.0	7.	33.	111.
SAMPLE 7	4.0	4.0	7.	27.	280.
SAMPLE 8	4.0	4.0	7.	48.	526.
SAMPLE 9	4.0	4.0	7.	22.	134.
SAMPLE 10	4.0	4.0	7.	24.	98.
SAMPLE 11	4.0	4.0	7.	21.	115.
SAMPLE 12	4.0	4.0	7.	21.	86.
SAMPLE 13	4.0	4.0	7.	20.	155.

SITE NUMBER 4

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	29.	210.
SAMPLE 2	4.0	4.0	7.	38.	161.
SAMPLE 3	4.0	4.0	7.	29.	105.
SAMPLE 4	4.0	4.0	7.	32.	285.
SAMPLE 5	4.0	4.0	7.	59.	476.
SAMPLE 6	4.0	4.0	7.	34.	222.
SAMPLE 7	4.0	4.0	7.	31.	371.
SAMPLE 8	4.0	4.0	7.	45.	636.
SAMPLE 9	4.0	4.0	7.	33.	236.
SAMPLE 10	4.0	4.0	7.	26.	124.
SAMPLE 11	4.0	4.0	7.	44.	128.
SAMPLE 12	4.0	4.0	7.	22.	87.
SAMPLE 13	4.0	4.0	7.	17.	402.

SITE NUMBER 5

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	35	462.
SAMPLE 2	4.0	4.0	7.	52.	304.
SAMPLE 3	4.0	4.0	7.	47.	131.
SAMPLE 4	4.0	4.0	7.	50.	161.
SAMPLE 5	4.0	4.0	7.	105.	518.
SAMPLE 6	4.0	4.0	7.	29.	92.
SAMPLE 7	4.0	4.0	7.	29.	238.
SAMPLE 8	4.0	4.0	7.	44.	396.
SAMPLE 9	4.0	4.0	7.	43.	169.
SAMPLE 10	4.0	4.0	7.	29.	92.
SAMPLE 11	4.0	4.0	7.	31.	133.
SAMPLE 12	4.0	4.0	7.	25.	100.
SAMPLE 13	4.0	4.0	7.	57.	248.

SITE NUMBER 6

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	25.	387.
SAMPLE 2	4.0	4.0	7.	36.	148.
SAMPLE 3	4.0	4.0	7.	29.	92.
SAMPLE 4	4.0	4.0	7.	33.	195.
SAMPLE 5	4.0	4.0	7.	15.	109.
SAMPLE 6	4.0	4.0	7.	28.	175.
SAMPLE 7	4.0	4.0	7.	25.	326.
SAMPLE 8	4.0	4.0	7.	20.	199.
SAMPLE 9	4.0	4.0	7.	33.	549.
SAMPLE 10	4.0	4.0	7.	13.	62.
SAMPLE 11	4.0	4.0	7.	23.	220.
SAMPLE 12	4.0	4.0	7.	28.	73.
SAMPLE 13	4.0	4.0	7.	20.	311.

SITE NUMBER 7

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	39.	354.
SAMPLE 2	4.0	4.0	7.	37.	171.
SAMPLE 3	4.0	4.0	7.	23.	90.
SAMPLE 4	4.0	4.0	7.	28.	144.
SAMPLE 5	4.0	4.0	7.	14.	77.
SAMPLE 6	4.0	4.0	7.	34.	547.
SAMPLE 7	4.0	4.0	7.	25.	199.
SAMPLE 8	4.0	4.0	7.	9.	172.
SAMPLE 9	4.0	4.0	7.	28.	138.
SAMPLE 10	4.0	4.0	7.	21.	79.
SAMPLE 11	4.0	4.0	7.	38.	286.
SAMPLE 12	4.0	4.0	7.	14.	205.
SAMPLE 13	4.0	4.0	7.	26.	24.

SITE NUMBER 8

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	25.	145.
SAMPLE 2	4.0	4.0	7.	32.	111.
SAMPLE 3	4.0	4.0	7.	16.	109.
SAMPLE 4	4.0	4.0	7.	18.	80.
SAMPLE 5	4.0	4.0	7.	15.	61.
SAMPLE 6	4.0	4.0	7.	37.	226.
SAMPLE 7	4.0	4.0	7.	18.	112.
SAMPLE 8	4.0	4.0	7.	29.	153.
SAMPLE 9	4.0	4.0	7.	30.	121.
SAMPLE 10	4.0	4.0	7.	26.	80.
SAMPLE 11	4.0	4.0	7.	42.	201.
SAMPLE 12	4.0	4.0	7.	21.	152.
SAMPLE 13	4.0	4.0	7.	19.	52.

SITE NUMBER 9

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	20.	74.
SAMPLE 2	4.0	4.0	7.	23.	95.
SAMPLE 3	4.0	4.0	7.	29.	128.
SAMPLE 4	4.0	4.0	7.	17.	91.
SAMPLE 5	4.0	4.0	7.	17.	69.
SAMPLE 6	4.0	4.0	7.	28.	142.
SAMPLE 7	4.0	4.0	7.	20.	92.
SAMPLE 8	4.0	4.0	7.	25.	117.
SAMPLE 9	4.0	4.0	7.	33.	130.
SAMPLE 10	4.0	4.0	7.	24.	84.
SAMPLE 11	4.0	4.0	7.	81.	311.
SAMPLE 12	4.0	4.0	7.	25.	116.
SAMPLE 13	4.0	4.0	7.	17.	78.

SITE NUMBER 10

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	17.	59.
SAMPLE 2	4.0	4.0	7.	10.	74.
SAMPLE 3	4.0	4.0	7.	22.	96.
SAMPLE 4	4.0	4.0	7.	22.	122.
SAMPLE 5	4.0	4.0	7.	18.	88.
SAMPLE 6	4.0	4.0	7.	14.	70.
SAMPLE 7	4.0	4.0	7.	18.	80.
SAMPLE 8	4.0	4.0	7.	18.	76.
SAMPLE 9	4.0	4.0	7.	21.	65.
SAMPLE 10	4.0	4.0	7.	38.	75.
SAMPLE 11	4.0	4.0	7.	70.	266.
SAMPLE 12	4.0	4.0	7.	26.	98.
SAMPLE 13	4.0	4.0	7.	17.	44.

SITE NUMBER 11

TOTAL FLOW = 14833.7 CUBIC METERS

	FLOW 1	FLOW 2	DAYS	ALPHA CNTS	BETA CNTS
SAMPLE 1	4.0	4.0	7.	18.	75.
SAMPLE 2	4.0	4.0	7.	30.	69.
SAMPLE 3	4.0	4.0	7.	18.	133.
SAMPLE 4	4.0	4.0	7.	19.	122.
SAMPLE 5	4.0	4.0	7.	12.	66.
SAMPLE 6	4.0	4.0	7.	18.	77.
SAMPLE 7	4.0	4.0	7.	8.	62.
SAMPLE 8	4.0	4.0	7.	11.	73.
SAMPLE 9	4.0	4.0	7.	20.	116.
SAMPLE 10	4.0	4.0	7.	21.	59.
SAMPLE 11	4.0	4.0	7.	62.	189.
SAMPLE 12	4.0	4.0	7.	15.	151.
SAMPLE 13	4.0	4.0	7.	18.	58.

----- COUNTS ENTERED -----

	U238	U235	U234	U232	DETECTOR	DAY
SITE NUMBER 1	78.	119.	586.	73.	1	1
SITE NUMBER 2	74.	27.	255.	54.	2	1
SITE NUMBER 3	251.	67.	861.	68.	3	1
SITE NUMBER 4	222.	65.	726.	48.	1	3
SITE NUMBER 5	401.	101.	1626.	53.	1	2
SITE NUMBER 6	345.	70.	486.	62.	2	2
SITE NUMBER 7	265.	43.	325.	47.	3	2
SITE NUMBER 8	244.	49.	288.	61.	2	3
SITE NUMBER 9	374.	57.	392.	78.	1	2
SITE NUMBER 10	254.	72.	372.	64.	2	2
SITE NUMBER 11	95.	31.	180.	31.	3	2

----- PRELIMINARY RESULTS ----
DISINTEGRATIONS PER MINUTE PER TOTAL FILTER

	U238	U235	U234	ALPHA	BETA
FILTER 1	2.31E+01	3.55E+01	1.70E+02	5.38E+02	1.04E+03
FILTER 2	3.01E+01	1.05E+01	9.98E+01	3.32E+02	1.13E+03
FILTER 3	8.05E+01	2.09E+01	2.72E+02	6.51E+02	2.56E+03
FILTER 4	1.02E+02	2.92E+01	3.29E+02	7.72E+02	3.71E+03
FILTER 5	1.66E+02	4.10E+01	6.70E+02	1.12E+03	3.20E+03
FILTER 6	1.22E+02	2.47E+01	1.69E+02	4.97E+02	2.98E+03
FILTER 7	1.23E+02	1.96E+01	1.44E+02	5.16E+02	2.53E+03
FILTER 8	8.76E+01	1.73E+01	1.00E+02	4.96E+02	1.52E+03
FILTER 9	1.05E+02	1.55E+01	1.06E+02	5.71E+02	1.43E+03
FILTER 10	8.66E+01	2.48E+01	1.27E+02	4.54E+02	1.07E+03
FILTER 11	6.60E+01	2.13E+01	1.20E+02	3.53E+02	1.11E+03

```
****************************************
*                                      *
*       AIR FILTER COMPOSITES          *
*                                      *
*           FINAL REPORT               *
*                                      *
*       SECOND QUARTER, 1983           *
*                                      *
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MICROCURIES PER CUBIC CENTIMETER

SITE NUMBER	U238	U235	U234	GROSS ALPHA	GROSS BETA
1	7.02E-16	1.08E-15	5.17E-15	1.63E-14	3.15E-14
2	9.13E-16	3.18E-16	3.03E-15	1.01E-14	3.43E-14
3	2.44E-15	6.35E-16	8.26E-15	1.98E-14	7.78E-14
4	3.09E-15	8.88E-16	1.00E-14	2.35E-14	1.13E-13
5	5.05E-15	1.24E-15	2.03E-14	3.39E-14	9.71E-14
6	3.70E-15	7.51E-16	5.13E-15	1.51E-14	9.06E-14
7	3.74E-15	5.94E-16	4.38E-15	1.57E-14	7.68E-14
8	2.66E-15	5.26E-16	3.04E-15	1.51E-14	4.60E-14
9	3.20E-15	4.71E-16	3.22E-15	1.73E-14	4.36E-14
10	2.63E-15	7.52E-16	3.86E-15	1.38E-14	3.24E-14
11	2.00E-15	6.47E-16	3.64E-15	1.07E-14	3.38E-14
DETECTION LIMITS:	3.87E-17	5.38E-17	1.31E-16	2.09E-16	2.19E-16

EQUATIONS USED IN THIS REPORT:

DETECTION LIMIT = (2 * (BACKGROUND ** 0.5)) / AVG FLOW PER SITE

ISOTOPIC CONC. = (NET CNTS. / TIME / EFF / REC) - (NET SAM BLK CNTS. / TIME / EFF / REC)

GROSS CONC. = NET CNTS. / TIME / EFF / PAPER FCTR.

FLOW = SUMMATION: AVG FLOW * 0.0283 M**3 / FT**3 * DAYS * 1440 MIN / DAY* 10E6 CM**3 / M**3

ALL VALUES WERE MULTIPLIED BY 2 TO ACCOUNT FOR THE TOTAL FILTER.

THESE VALUES WERE CHECKED AND APPROVED BY ______________________.

DISTRIBUTION

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